The Airman and the Weather

Aeronautic Meteorology: A New Branch of Applied Science

By Charles Fitzhugh Talman

AERONAUTICAL meteorology is to the aeronaut what maritime meteorology and hydrography, together, are to the mariner. That it is destined to play an all-important part in the navigation of the air is so obvious as to require no demonstration. Taking this for granted, there are, however, certain questions to be answered in order to fix the status of this branch of knowledge in the aeronautical curriculum. How much, actually, do we know about the laws of the atmosphere bearing on aeronautics? Has the science reached a practical stage, or is it still so tentative and uncertain that, for the present, the individual aeronaut should look upon his personal experience as a safer guide than the generalized knowledge now available? Is the meteorologist still, as formerly, learning more about the free atmosphere from the aeronaut than the latter is learning from the meteorologist?

If for any reason the world became interested in blowing soap bubbles we should not have long to wait for an exhaustive "Lehrbuch der Seifenblasenkunde" from Germany. It was in the normal order of events that a German gave us the first text book of aeronautical meteorology[1], and that we are promised from the same pen a companion work on aeronautical climatology; but it is safe to say that few meteorologists were prepared to find in Dr. Linke's pioneer work a complete new branch of applied science, embodying a wealth of information not only useful, but indispensable, to every person who risks life and limb in navigating the air. This book fully answers the questions we raised a moment ago. Aeronautical meteorology has arrived.

The present writer has reviewed Linke's book in the SCIENTIFIC AMERICAN (June 24th, 1911, p. 630, and April 20th, 1912, p. 368), and it is not necessary to repeat here what has already been said about its many merits. The young German author, though himself a practical aeronaut as well as a meteorologist, is of course primarily a mere spokesman for the scientific aeronauts of his country, and his work reflects credit upon many besides himself. Our purpose now is simply to cite a few facts from the work in question, and from other recent literature, serving to show to what extent meteorology is already prepared to take up the new tasks imposed upon it by the sudden efflorescence of the art of aeronautics.

It was a providential circumstance that meteorologists had made a substantial beginning in the systematic study of the upper air a few years before the invention of the first practical aeroplanes and dirigible balloons. The new science of aerology—i. e., the survey of the atmosphere throughout its vertical extent, by all possible methods—dating, as a coherent body of knowledge, from about the beginning of the present century, pushes its investigations some three hundred miles above the earth. The balloonist, in extreme cases, rises 6½ miles; the aviator, 2½ miles. Thus it happens that much of the matter of aerology has no direct bearing on aeronautics. Even the remarkable isothermal layer, or stratosphere, the discovery of which, in the year 1902, marked an epoch in the history of science, lies at such an altitude that it is doubtful whether any human being will ever travel up to its lower boundary; though it is now almost daily entered by unmanned balloons carrying self-registering instruments. As to the lofty regions, beyond the reach of the sounding-balloon, in which the atmosphere is no longer "air," but hydrogen, or helium, or "geocoronium," or what-not, these are of no more practical concern to the aerial navigator than to the prosaic wayfarer on *terra firma*.

[1] F. Linke, *Aeronautische Meteorologie*, 2 vols., Frankfurt a. M., 1911.

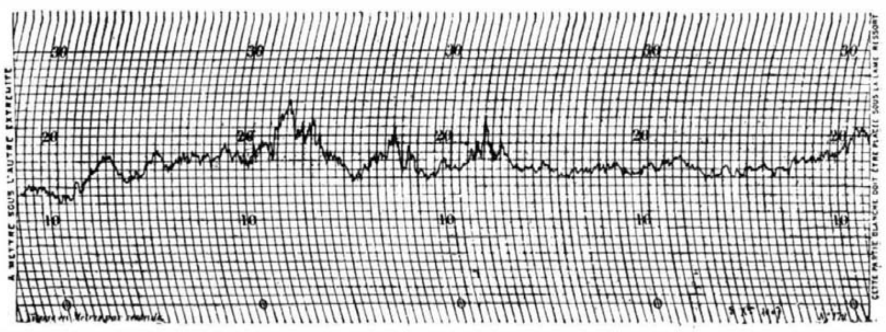
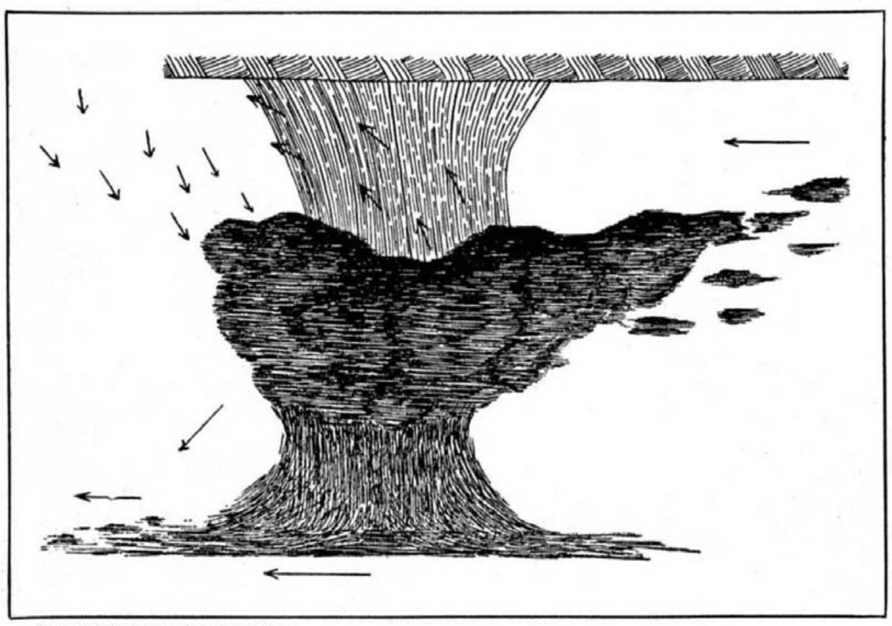
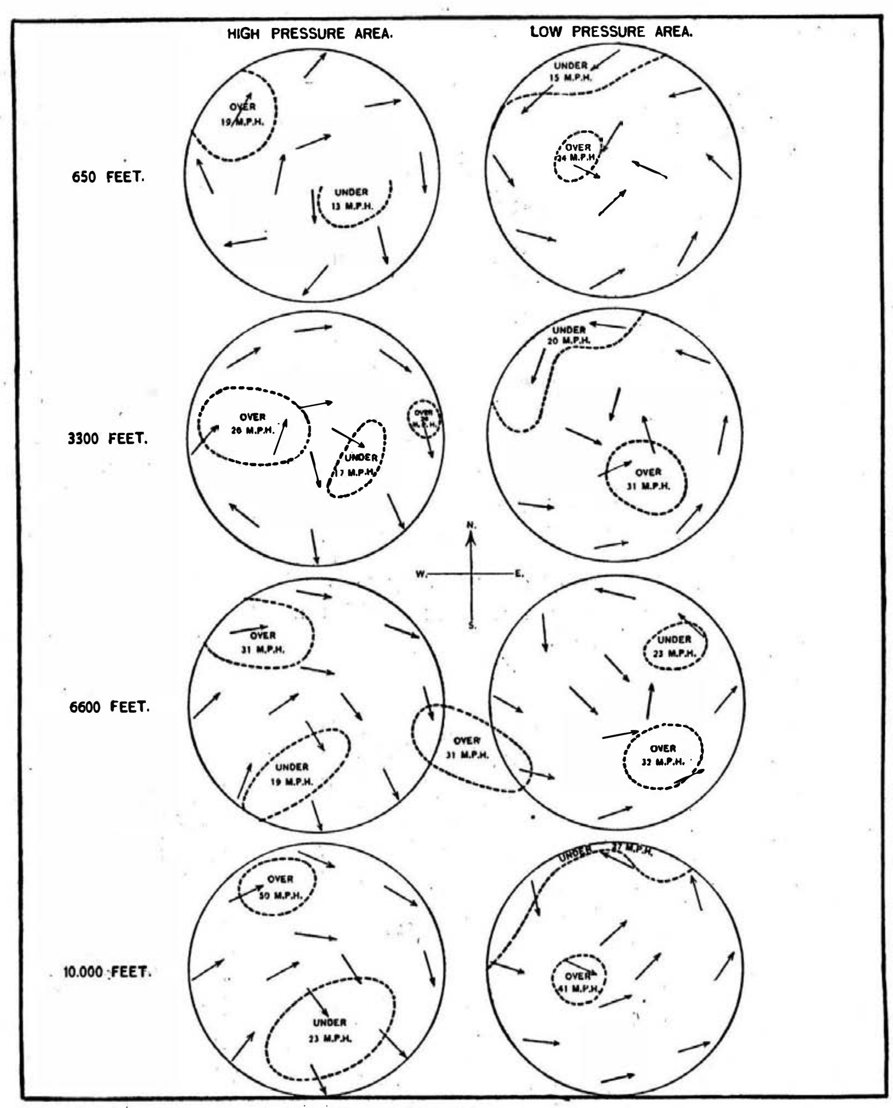


Fig. 1.—Gustiness of the wind. Shown by the record of a Richard anemocinemograph. The speed of the wind at each moment is here registered in meters per second.



From Linke's *Aeronautische Meteorologie.*

Fig. 2.—"It is notorious that the greatest enemy of all kinds of air-navigation is the thunderstorm; . . . not only because of its electrical dangers, but because of the strong vertical air movements by which it is attended."—Linke.



From Rotch and Palmer's *Charts of the Atmosphere* (New York, 1911: John Wiley & Sons).

Fig. 3.—Variations of the force and the direction of winds at different altitudes in high and low-pressure areas.

However, in order to reach the stratosphere every sounding-balloon must pass through the troposphere, and all ascents of meteorological kites are confined within this lower stratum. Thus the great bulk of the data acquired by the aerologist pertains to regions accessible to the aeronaut.

Before all things else the aeronaut is interested in the wind. The combined labors of the aerologist and the aeronautical engineer have completely upset old-fashioned ideas concerning this element. No longer do we think of a wind as a steady horizontal stream of air, in which every particle is moving at the same speed as every other particle. Such a wind would be a boon to the aeronaut if it existed, but it does not—as was first conclusively proved by Langley, and as is shown in the record of every aerological observation. In the first place, a wind is rarely horizontal, but has, instead, a more or less pronounced vertical component, of which the ordinary wind-vane and anemometer give not the slightest token. In the second place, no wind is absolutely steady or homogeneous; and most winds are quite the reverse. When two anemometers are placed side by side, a few feet apart, one of them may, for a brief period, indicate a velocity twice as great as the other. Moreover, a single anemometer, if sufficiently delicate, will show incessant fluctuations in the strength of the wind. This "gustiness" is not well brought out in the records of the ordinary registering anemometer, but it is strikingly shown in those of the Dines pressure-tube anemometer, or the Richard anemocinemograph (Fig. 1), or the apparatus attached to the winch of a meteorological kite for recording the tension on the kite-wire.

That the wind commonly has a vertical component, that gustiness is the rule rather than the exception, and that great variations in velocity occur from one place to another, are facts that the aeronaut would soon find out for himself. It is the business of the meteorologist to tell him under what conditions he may expect these features to be most pronounced or most persistent, and what limiting magnitudes they may assume.

For example, the meteorologist teaches the aeronaut to distinguish the typical forms of clouds, for the very practical purpose of enabling him to recognize those forms which are characteristic of vertical air movements, and those which denote mainly horizontal movements. A cumulus cloud is proof positive of the existence of a strong ascending current beneath it; while in the intervals between neighboring cumuli the air is likely to be sinking. Prof. Humphreys has happily described these vertical movements as "aerial fountains" and "aerial cataracts," and has shown that they are among the numerous causes of the so-called "hole in the air."

What maximum speed may be attained by vertical air currents? This is a question that the aeronaut would hardly care to have answered by a personal encounter with the extreme case of the phenomenon. The meteorologist, with the statistics of almost innumerable observations at his command, is able to tell him that ascending currents sometimes move at the rate of 25 or 30 feet a second, and that these rapid movements in the vertical occur especially in connection with thunder-squalls. Furthermore, the meteorologist

(Concluded on page 101.)

© 1913 SCIENTIFIC AMERICAN, INC

Good Bearing Metal

Good Bearing Metal means long lived bearings. And long lived bearings means a long lived machine requiring little or no attention and consequent low maintenance cost.

HIGH SPEED NON-GRAN BEARING BRONZE

NON-GRAN resists wear for from three to five times longer than any other bearing bronze.

That is why the E. I. Du Pont de Nemours Powder Company invariably use NON-GRAN when they have to replace the original bearings in their manufacturing equipment. NON-GRAN costs them more than any other bronze, but once it is in place it keeps their machines in commission for from three to five times longer than could any other metal. Scores of other manufacturing corporations are keeping their machines in more constant operation and are minimizing maintenance cost in just this same way.

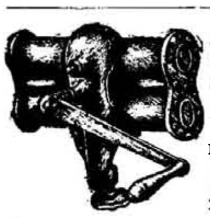
A bearing wears out because friction keeps pulling away the tiny particles constituting the bearing metal. That is why the inside diameter of a bearing keeps getting larger and larger as wear goes on. The particles simply being pulled right out from the body of the bearing.

In direct contrast with other bearing bronzes, NON-GRAN is non-granular in structure. The whole mass is of a tough cohesive structure. Each of the billions of constituent particles is securely knit to all adjacent particles. This enables the particles on the bearing surface to resist the frictional pull to which they are subjected.

Do you want to save money on the maintenance of *your* manufacturing equipment?

Drop us a line to-day and we will give you full data regarding this wonderful metal which is annually saving hundreds of thousands of dollars to those who are using it.

AMERICAN BRONZE CO.
1733-1757 CARTON BLVD.
BERWYN, PENNSYLVANIA

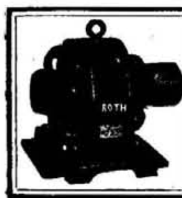


AGENTS

Send for our proposition on the Hawthorne Four Cylinder Automobile Hand Air Pump.

HAWTHORNE MFG. CO., Inc.
38 Spruce Street, Bridgeport, Conn

PALMER MOTORS AND LAUNCHES 2 AND 4 CYCLE
Catalogue M Free of Motors. Catalogue B Free of Boats.
ENGINES FROM 2 TO 40 H.P. IN STOCK PALMER BROS. Cos Cob, Conn.



ELECTRIC MOTORS Dynamos
SPECIAL MACHINES Grinders Polishers
ROTH BROS. & CO.
198 Loomis Street. Chicago, Ills.

CRUDE ASBESTOS
DIRECT FROM MINES
PREPARED Asbestos Fibre for Manufacturers use
R. H. MARTIN
OFFICE, ST. PAUL BUILDING
220 Broadway, New York

ICE MACHINES Corliss Engines, Brewers' and Bottlers' Machinery.
The VILTER MFG. CO.
899 Clinton Street, Milwaukee, Wis.

Magical Apparatus
Grand Book Catalog. Over 700 engravings 25c. Parlor Tricks Catalog Free.
MARTINKA & CO., Manufacturers, 493 Sixth Avenue, New York

LEARN TELEGRAPHY
MORSE and WIRELESS at home with OMNIGRAPH AUTOMATIC TEACHER in half usual time—trifling cost. Sends you messages without limit automatically—easily become expert. Price $2.00. Catalog free. OMNIGRAPH MFG. CO. Dept. 16. 39 Cortlandt Street, New York.

TELESCOPES
W. & D. MOGEY
PLAINFIELD, N. J.

SETS OF CASTINGS OF MODEL ENGINES
GEAR WHEELS & PARTS OF MODELS
MECHANICAL SUPPLIES AND MATERIAL of all kinds
EXPERIMENTAL AND LIGHT MACHINE WORK to order
132 MILK STREET, BOSTON

nuclear division figures, with various kinds of outgrowths, had been described by Leduc in earlier writings, together with the osmotic growths of various kinds, suggesting molds, sea-weeds, toadstools, etc. Both series of phenomena were referred to and illustrated in the SCIENTIFIC AMERICAN, September 9th and 23rd, 1911. Fig. 4 is a reproduction of one of Leduc's "artificial" nerve cells, shown alongside of a ganglionic cell (Fig. 5) prepared by Demoor according to Golgi's method. Leduc's "cell" was produced by placing a "seed" consisting of two parts of copper sulphate and one part of cane sugar in a solution of ferrocyanide of potassium. A precipitate of copper ferrocyanide is formed on the surface; this is impervious to sugar, but water is readily absorbed through it, leading to "growth" in all directions, the final form depending upon the precise distribution of the particles of sugar and of copper sulphate in the grain, upon variations in the density of the medium, etc.

Much of the argument in the book is devoted to showing that the lines of dynamic discharge are essentially the same in an organism and in organic media. To this end illustrations are derived from a comparison of electric discharges and crystallization figures with ferns and other plant structures. Fig. 8 is the electric discharge resembling a leaf; Fig. 10, an electrolytic pattern suggesting a fern frond; Fig. 11, a crystallization of ammonium chloride in gelatin suggesting plant forms; Fig. 9, four successive stages in "karyokinetic" figures produced by diffusion; Fig. 12, a modification of diffusion currents by contact of a glass rod, illustrating irritability; and Fig. 13 shows "negative heliotropism" of diffusion currents of India ink in salt solution.

With wonderful patience and ingenuity Prof. Leduc has taken up in turn the commonly recognized characteristics of living cells—their structure, their absorption of nutrients, their nuclear division, their irritability, the circulation, the relation of temperature to function, their transformation of energy—and has reproduced each phenomenon in turn in a preparation which is admittedly "non-living." But has he thereby made an approach to the artificial synthesis of life? All that we can learn from these experiments is that the laws of motion and of matter are as evident in the world of living things as in the world of non-living; that motion here is along the line of least resistance as it is there; that the mechanics and the electrics and the chemics of living cells are the same as those of non-living systems.

The chapter on the origin of life and spontaneous generation is a sane statement of the problem, and in it Dr. Leduc points out the logical necessity of assuming that life not only did originate "spontaneously"—in a scientific sense—but may do so again under suitable conditions. He also points out the evasion of the issue involved in such theories as that of Arrhenius in regard to the extra-terrestrial origin of life.

Whether the methods of Leduc ever reach the bottom of the problem or not, these experiments have their value in clearing the field of much conjectural rubbish and confusion; and as for the synthesis—that has not yet reached the experimental stage.

The Airman and the Weather

(*Continued from page 94.*)

is now able to draw a vertical plan of the thundersquall (Fig. 2), tracing its quasi-circulation about a horizontal axis, as a guide to the maneuvers the airman should adopt if overtaken by a storm of this character. This is strikingly analogous to the task of the nineteenth century meteorologist in tracing the ground plan of the cyclone, and teaching the mariner how to avoid the "dangerous semicircle."

However, the aeronaut needs horizontal as well as vertical plans of the wind systems he is likely to encounter—cyclones and anticyclones, land and sea breezes, trade winds and antitrades, and all the

De Montluzin St., Gentilly Terrace, New Orleans, La., Constructed with "Tarvia X"

Fifty Million Yards Treated

THE rear wheels of an automobile revolve more times to a mile than the front ones do.

There is a certain amount of slip when the car is driven at high speed and this slip exerts upon the road surfaces a powerful and destructive abrasive effect exactly like that of an emery wheel.

Ordinary macadam never was expected to withstand such strains and soon goes to pieces unless it is given constant and costly care.

A macadam road, to meet the demands of modern traffic, requires the use of an additional binder to reinforce the surface. Tarvia is ideal for this purpose and has been used successfully on over 50,000,000 yards of roadways and pavements in this country.

Tarvia may be applied to the road during construction or merely as a surface application.

There is such a vast economy in maintenance expense that it more than balances the cost of the Tarvia treatment.

Tarvia is made in three grades—"Tarvia X," very heavy and dense for road construction where the voids are large; "Tarvia A," a lighter grade for the smaller voids which occur in surface operations; "Tarvia B," applied cold for dust suppression and surface maintenance.

Booklets on request.

BARRETT MANUFACTURING COMPANY
New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland Cincinnati Minneapolis Pittsburgh Seattle Corey, Ala.
The Paterson Mfg. Co., Ltd.—Montreal. Toronto, Winnipeg, Vancouver, St. John, Halifax. Sydney, N.S
TRADE B MARK

¶ *The* CONSTRUCTION *of an* INDEPENDENT INTERRUPTER
Clear diagrams giving actual dimensions are published. Supplement No. 1615 gives a clear and concise description on the construction of an Independent Interrupter. Order from your newsdealer or from *Munn & Co., Inc., 361 Broadway, N. Y.*

Handsome Structures Everywhere Built with Hy-Rib

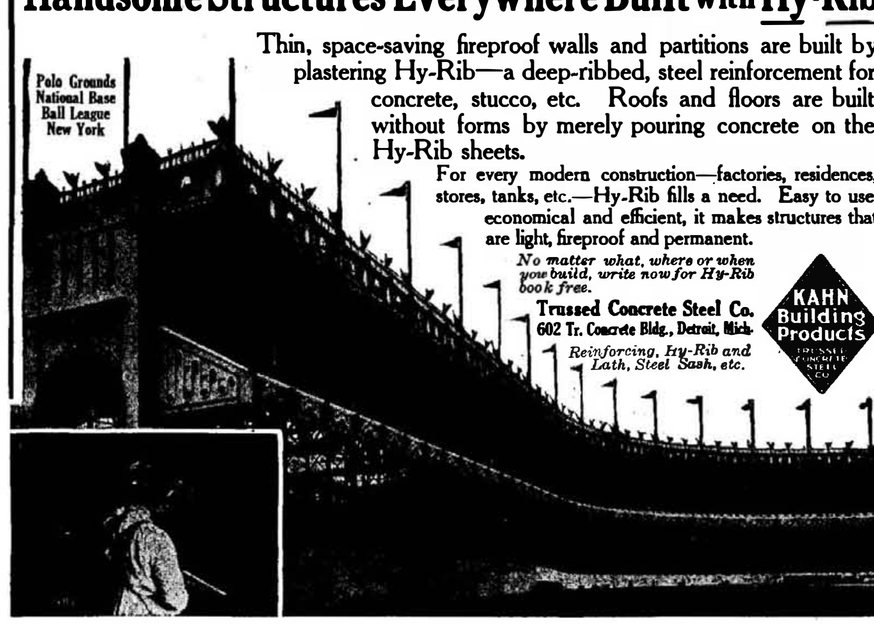
Thin, space-saving fireproof walls and partitions are built by plastering Hy-Rib—a deep-ribbed, steel reinforcement for concrete, stucco, etc. Roofs and floors are built without forms by merely pouring concrete on the Hy-Rib sheets.

For every modern construction—factories, residences, stores, tanks, etc.—Hy-Rib fills a need. Easy to use. economical and efficient, it makes structures that are light, fireproof and permanent.

No matter what, where or when you build, write now for Hy-Rib book free.

Trussed Concrete Steel Co.
602 Tr. Concrete Bldg., Detroit, Mich.
Reinforcing, Hy-Rib and Lath, Steel Sash, etc.

KAHN Building Products



Polo Grounds National Base Ball League New York

THIS IS THE NEW FOX No. 24

"Better Than the Best of All Others"

SAMPLES AT WHOLESALE

Agents wanted—big commissions—monthly payments—trial shipments—new stock—visible models—low wholesale prices. New advertising now ready

Write today for Agency offer. Mention Scientific American.

Use the Coupon ☞

Fox Typewriter Company
GRAND RAPIDS, : : MICHIGAN

FROM A SCIENTIFIC AMERICAN READER
Name......................................
Address......................................
Business......................................

© 1913 SCIENTIFIC AMERICAN, INC

other members of the atmospheric circulation. He needs to know, for example, the relation of the winds to the isobars at various levels in a typical cyclonic disturbance. It is a distinct advantage to him to learn that, while at the earth's surface the winds blow spirally inward toward the center of a depression, at the mile-level overhead they are no longer inclined inward, but blow in such a direction that the isobars on the surface weather map correspond approximately with the motion of a free balloon at such a level. Thus aeronautical meteorology, which is a science of three dimensions, is vastly more complicated than marine meteorology, which is a science of only two.

Let us repeat, however, that in spite of the magnitude of the tasks imposed upon it, aeronautical meteorology has already reached a stage of great practical utility. A single illustration will make this clear. Suppose plans were on foot to establish a regular airship service across the Atlantic, where would be the most favorable route? Meteorology is ready to answer this question. For the westward journey there is one region, and one only, in which the winds are favorable throughout the year, viz., the trade-wind belt. For the eastward journey a sea-level wind chart might suggest the advantage of a more northerly route, in the zone of "prevailing westerlies." Aerology, however, can better this suggestion. The winds of middle latitudes, although westerly in terms of averages and resultants, are actually subject to the vicissitudes attending the frequent passage of cyclonic disturbances. There is only one region in which there is a tolerably steady drift from west to east, and this is the zone of the anti-trades,[2] lying vertically over the trade winds. Hence the first transatlantic airships will probably sail from southern Europe to the West Indies at a low level, and return in the same latitudes at a level a few thousand feet higher. The tropical hurricanes that occasionally invade this region during the late summer and early autumn will be announced by wireless telegraphy from the meteorological bureaus, and the aerial liners will give them a wide berth—or possibly rise to the upper level of the storm itself and take advantage of the outflowing winds at that level to get away from the storm center.

Aerologists have now been at work for several years sounding the air above the trade-wind belt. The trades are found to be quite shallow, and their depth varies considerably with latitude.

We have not space here for even the most summary digest of the science of aeronautical meteorology, but must limit ourselves to an enumeration of its principal subdivisions. We have already devoted considerable space to the wind, as the subject of capital importance. Under this head let us add that valuable statistics have been compiled as to the variation of the force and the direction of the wind with altitude (see, for example, Fig. 3); that the average windiness of various places on the earth's surface has been determined, in order to point out the most favorable locations for aerial harbors and aerodromes; that the relation of the winds at moderate altitudes to the topography of the land has been worked out in great detail; and that ingenious forms of apparatus (e. g., the vertical anemometer and the pilot-balloon) have been devised, to supplement the ordinary anemometer and wind-vane for aeronautical purposes. The elaborate investigations on wind pressure and the like carried out in aerodynamic laboratories, belong to engineering rather than to meteorology.

Temperature is a very important factor in ballooning; less important in aviation. Here, again, aerology has gathered a great fund of information. We know not only the normal temperature gradients in the atmosphere, but also under what conditions these gradients are likely to be interrupted or reversed. The typical vertical and horizontal distribution of temperature in cyclones and anticyclones—a subject concerning which very erroneous opinions formerly prevailed—has now been approximately determined.

So with the other meteorological elements. Each of them, thanks to the advent of aerology, has now been studied for several years from the three-dimensional point of view, which is the point of view of aeronautics.

Of the special storm warning services for aeronauts recently established or projected we have not space to speak. They are the logical corollary of the science of aeronautical meteorology, and will soon be commonplace institutions the world over.

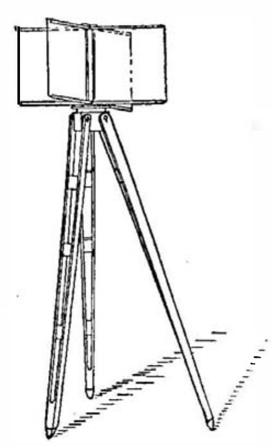
[2] The term "antitrade" is sometimes used in a broad sense to include not only the high-level wind above the trades, but also the supposed extension of this wind at sea-level in higher latitudes, i. e., the "westerlies" of the temperate zone. It is here applied to the upper current of the tropical belt only.

Device for Detecting Flight of Mosquitoes

By L. E. Haskell

An instrument for detecting the direction of flight of adult mosquitoes has been invented by E. F. Quimby and has been put in operation with a great deal of success on the Isthmian Canal Zone. Mr. Quimby, division inspector in the Department of Sanitation on the Canal Zone, perfected his device for the purpose of ridding the more remote parts of the zone from mosquitoes.

The device consists of a metal frame holding four plates of glass each 12 by 12 inches in size, placed upon a tripod. The glass plates are held stationary at right angles to one another, so that when the instrument is set up, they point north, east, south and west. To catch the mosquitoes, a coat of tanglefoot, composed of one half pound of rosin to one liter of castor oil, is prepared, and when applied to the glass is practically transparent.



Device for detecting the flight of mosquitoes.

Many interesting and important facts regarding the habits of the mosquito have been learned. It was found that the adult mosquito flew on the quarter of an eighteen mile an hour wind; that the evening flight occurred between 6:10 and 7:10 o'clock; that there was a complete lull in the flight after 7:10 o'clock; and that there was a return flight between 5:50 and 6:40 o'clock in the morning, also on the wind's quarter.

The instrument has proved to be useful in locating breeding places by eliminating the area facing the plates that do not show a catch. It has established a means of finally exterminating mosquitoes on the Canal Zone. The device points out the direction of the breeding places; a thorough search; the discovery of swampy ground or pools of stagnant water; a little kerosene; and the breeding place is clean.

A Combined Life-boat and Marine Safe.—The patent No. 1,064,472, to August Haas of Grapeville, Penn., shows a ship with a berth open at one end through a wall of the ship and having downwardly and outwardly inclined slideways with an emergency boat having its greatest depth at its stern and decreasing in depth toward its bow and supplied with runners so that it can be supported on the slideways, with securing means for removably holding the boat in the berth.

A pocket KNIFE SHARPENER FREE

The tough, sharp crystals of a Pike India Oilstone just *eat* steel. It's fun to see how quickly they put a dandy, keen edge on carvers, kitchen knives, tools, etc. No other stone cuts so fast without losing its shape. Adopted now by manual training schools, big machine shops, etc. Nothing like it. This is only one of the famous

PIKE SHARPENING STONES

"The only line that includes every sharpening substance—natural or artificial—each the best for some sharpening need."

Every home needs one. Hardware and tool stores everywhere sell them.

Let us mail you a Pike India Vest Pocket Stone for pocket knives, office use, etc. Just send your dealer's name and 4c. for packing and mailing. We include "*How to Sharpen*"—greatest book ever written on sharpening and how to select and care for oilstones. You'll be pleased. Write today.

PIKE MANUFACTURING CO.
155 Main St., Pike, N. H.

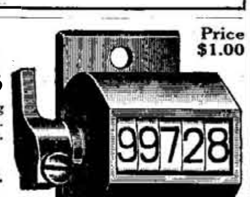
Your Motor Boat CAN BE OPERATED WITH KEROSENE. USE THE AERO INSPIRATOR
Bulletin 19 Free SATISFACTION GUARANTEED.
UNIVERSAL EQUIPMENT CO. 24 Stone St., NEW YORK

Scientific and Technical BOOKS

We have in preparation a new catalog of scientific and technical books, which will be ready for distribution about April 15th. This catalog will contain the titles and descriptions of 3500 of the latest and best books covering the various branches of the useful arts and industries.
Our "Book Department" can supply these books or any other scientific or technical books published and forward them by mail or express prepaid, to any address in the world on receipt of the regular advertised price.
Send us your name and address, and a copy of this catalog will be mailed to you, free of charge, just as soon as it is printed.

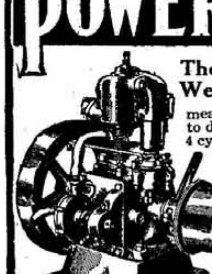
MUNN & CO., Inc.
Scientific American Office
361 Broadway New York, N. Y.

VEEDER Counters



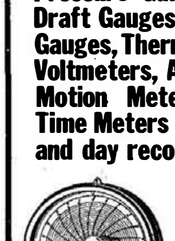
to register reciprocating movements or revolutions. Cut full size. Booklet free.
VEEDER MFG. CO.
18 Sargeant St. Hartford, Conn.
Cyclometers, Odometers, Tachometers, Counters and Fine Castings.
Represented in Great Britain by Markt & Co. Ltd., 6 City Road, Finsbury Sq., London, E.C.; France, by Markt & Co. Ltd., 107 Avenue Parmentier, Paris; Germany, Austria-Hungary and Scandinavian Countries by Ludw. Loewe & Co., Hutten Strasse 17-20, Berlin.

POWER For all Purposes



The High Powered, Light Weight Cushman Engine measures out just enough gasoline to do the work required. Advanced 4 cycle type. Weight under 200 lbs. 4 h. p. rating but actually develops over 5 full horse power.
Automatic Throttle Governor with High Grade Schebler Carburetor.
Easy speed changes, special friction clutch pulley. Also new 6-8 and 20 h. p. high efficiency engines for heavy work. Now ready. Book free. Address
CUSHMAN MOTOR WORKS, 2070 N. St., Lincoln, Neb.

BRISTOL'S RECORDING
Pressure Gauges, Vacuum Gauges, Draft Gauges, Differential Pressure Gauges, Thermometers, Pyrometers, Voltmeters, Ammeters, Wattmeters, Motion Meters, Tachometers and Time Meters make continuous night and day records.



Whenever you are in need of Recording Instruments for any purpose whatever, write us for expert recommendations and quotations on instruments especially adapted to your requirements.
Write for Condensed General Catalog 160-N
The Bristol Company
WATERBURY, CONN.
4835

Valuable Books

The Modern Gasoline Automobile
ITS CONSTRUCTION, OPERATION, MAINTENANCE AND REPAIR.
By VICTOR W. PAGE. Octavo, 693 pages, over 400 illustrations and folding plates. Price, $2.50.
¶ The most complete, practical and up-to-date work published on the gasoline automobile, for owners, operators, repairmen, salesmen and all others who are connected with the automobile industry in any capacity. It contains the latest and most reliable information on all phases of gasoline automobile construction, operation, maintenance and repair. It is clearly and concisely written by a recognized authority, familiar with every branch of the automobile industry, and is just as valuable as a reference and compendium of the latest automobile practice as it is desirable as a text book for teaching the beginner. It is not too technical for the layman nor too elementary for the more expert. Every part of the automobile, its equipment, accessories, tools, supplies, spare parts necessary, etc., has been fully discussed. It tells you just what to do and how and when to do it. Nothing has been omitted, no detail has been slighted. This work is superior to any treatise heretofore published and is right up to date and complete in every detail.

Scientific American Reference Book
EDITION OF 1913.
Compiled and Edited by ALBERT A. HOPKINS and A. RUSSELL BOND, 12mo., 597 pages, 1000 illustrations. Price, $1.50.
¶ A handy, compact, reliable and up-to-date volume for every-day reference, containing a remarkable aggregate of facts, statistics and readable information along industrial, commercial, scientific and mechanical lines of interest to everyone. This volume is a revelation in the nature of facts and figures relating to population, manufactures, commerce, railroads, shipping, mining, agriculture, education, aviation, armies and navies of the world, Panama Canal, post office affairs, telephony, telegraphy and wireless telegraphy, patents and copyrights, chemistry, astronomy and time, meteorology, mechanics, weights and measures, and thousands of other subjects. It will prove invaluable on the desk of the business man as well as the library of the home. No expense or effort has been spared to make it interesting as well as authoritative.

Wireless Telegraphy and Telephony Simply Explained
By ALFRED P. MORGAN. 12 mo., 154 pages, 156 illustrations. Price, $1.00.
¶ A popular, practical and simply worded treatise embracing complete and detailed explanations of the theory and practice of modern radio apparatus and its present-day applications. The author has filled a long-felt want and has succeeded in furnishing a lucid, comprehensive treatise for the operator, both amateur and professional. A close study of its pages will enable one to master all the details of the wireless transmission of messages and to design and construct his own apparatus. Although based on scientific principles, no attempt has been made to give mathematical explanations. It is written so that it can readily be understood by men who are not technical and at the same time is sufficiently comprehensive and practical to be studied advantageously by the ambitious young engineer or experimenter.

The Scientific American Handbook of Travel
With Hints for the Ocean Voyage, for European Tours, and a Practical Guide to London and Paris.
Compiled and Edited by ALBERT A. HOPKINS. 12 mo., 503 pages, 500 illustrations. Price, flexible cloth, $2.00; full flexible leather, $2.50.
¶ This is an indispensable companion for the European tourist, and contains more miscellaneous information on travel and subjects of interest to travelers than can easily be found in any other form. It is unlike any other guide that has been published and is not intended to take the place of descriptive guides, but as a complement to all of them. It also forms an excellent reference volume for all in any way interested in the ocean and its navigation, as it contains many facts presented in an interesting and readable form, and tells you exactly what you have wanted to know about the trip abroad and the ocean voyage. Excellent maps of Paris and London, a complete automobile roadmap of Europe, and several other maps are included in a pocket at the end of the book.

The Scientific American Cyclopedia of Formulas
Edited by ALBERT A. HOPKINS. Octavo, 1077 pages. 15,000 Receipts. Cloth, $5.00; half morocco, $6.50.
¶ This valuable work is a careful compilation of about 15,000 selected formulas, covering nearly every branch of the useful arts and industries. Never before has such a large collection of valuable formulas, useful to everyone, been offered to the public. Those engaged in any branch of industry will probably find in this volume much that is of practical use in their respective callings. Those in search of salable articles which can be manufactured on a small scale, will find hundreds of most excellent suggestions. It should have a place in every laboratory, factory and home.

Concrete Pottery and Garden Furniture
By RALPH C. DAVISON. 16mo., 196 pages, 140 illustrations. Price, $1.50.
¶ This book describes in detail in a most practical manner the various methods of casting concrete for ornamental and useful purposes. It tells how to make all kinds of concrete vases, ornamental flower pots, concrete pedestals, concrete benches, concrete fences, etc. Full practical instructions are given for constructing and finishing the different kinds of molds, making the wire forms or frames, selecting and mixing the ingredients, covering the wire frames, modeling the cement mortar into form, and casting and finishing the various objects. With the information given in this book, any handy man or novice can make many useful and ornamental objects in cement for the adornment of the home or garden. The information on color work alone is worth many times the cost of the book.

Any of these books will be sent postpaid on receipt of advertised price

MUNN & CO., Inc., *Publishers*
361 Broadway, New York City

© 1913 SCIENTIFIC AMERICAN, INC